Dynamic SLA-based resource management mechanisms for virtualized IMS platform

## Motivation and problem definition

NGN (Next Generation Network) is a concept that has been introduced to take into account the new changes in the telecommunications field. The NGN proposes economic and technical aspects of networking. Economically, it increases the number of production by creating new business model based on user presences and related to multimedia services (e.g., Voice over IP, Video conferencing, streaming, and push to talk). Furthermore, costs reduction for infrastructures maintenance is considered by NGN where only one type of transport network is required instead of ones for each access network. Technically, it makes the network architecture more flexible in term of adding new services easily with supporting scalability.

The core network of NGN is IP Multimedia Subsystem (IMS) standardized by 3rd Generation Partnership Project (3GPP) in order to offer deployment of new rich media communication services mixing telecom and data services[2]. One of solution for NGN control plane is IMS which consists of CSCFs as session control and service triggering servers, HSS as central service and network database and ASs as session related services provider to users.

However, IMS is not implemented truly for a decade because of cost and complexity of required standards. In recent years by introducing two technologies to the network, IMS becomes momentous technology. The first reason is virtualization technology which enables the physical machine to run one or more virtual machines at same time[3]. The second contributed technology is LTE (Long Term Evolution). The telecom industry has identified LTE as the best way of implementing packet-based mobile network which provides much more bandwidth at a better price. Most industry experts agree the best way to deliver voice on LTE is to use IMS[4].

Cloud computing is a promising paradigm that promotes computing-as-a-service model, in which a dynamic pool of virtualized computational resources can be leased and released on demand. Some of the key benefits of the cloud computing model include: resource efficiency through sharing; high scalability and elasticity through dynamic resource management and pooling; and ease of introduction of new applications and services through substrates reuse.

Leveraging cloud technologies (e.g. hardware virtualization, virtual switches, smart NICs, poll-mode Ethernet drivers, orchestration and management mechanisms) as key enabler, an emerging concept called Network Function Virtualization (NFV) is being contemplated in the telecom domain. The main goal behind the NFV concept, which is specified by the European Telecommunications Standard Institute (ETSI)[5], is to enable the consolidation and sharing of various software-based, virtualized, telecom networking resources, running on cloud infrastructures[6]. This network virtualization and telecom infrastructure cloudification and sharing is expected to play an important role in reducing the deployment and operation costs of future telecom infrastructures, while opening the door for innovation and performance enhancements in the current telecom networking architecture. Software Define Networking (SDN) solution as a software networking enabler, offers a physical separation of the control plane of the network from the forwarding plane[7].This migration of control messages enables the underlying infrastructure to be abstracted for applications and network services which can treat the network as a logical or virtual entity. SDN and NFV solutions together could provide a self-healing network in term of automatically network troubleshooting and network reconfiguration by instantiating virtual network services and entities.

Despite its merits, the IMS still faces important challenges in terms of scalability and elasticity. In fact, by using text-based, bandwidth-hungry, and delay-inducing protocols (such as SIP), and also with the constant increase in users demands and their number, IMS nodes can become quickly overloaded, as shown in[8]. Such overload impacts the Quality of Service (QoS) offered to users and results in the lack of ability to meet SLA requirements. In addition, the current IMS design lacks the ability of dynamically dimensioning network nodes based on load and demand, and does not implement adaptive resource management mechanisms.

## Objectives

This research project addresses issues related to dynamic resource management in virtualized IMS platform. The main question this project attempts to answer is: How the legacy IMS platform can be virtualized, distributed and adapted to provide efficient, flexible and fine-grained resource management to satisfy different user needs and requirements (SLA and QoS). The fundamental goal of this research project thesis is to define and validate scalability and elasticity mechanisms to dynamically and efficiently manage resource in virtualized and distributed IMS platforms by taking advantage of the cloud computing paradigm and virtualization concept. Furthermore, another goal of this project is to define and validate distribution strategies of IMS nodes based on SLA and self-organized IMS network strategies based on offered loads, QoS, and SLA by taking advantages of SDN/NFV concepts. This project will open new dimensions for Mobile Virtual Network Operators (MVNOs) to use virtual IMS over LTE to offer voice and other rich communication services based on user's needs and service provider requirements.

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[4] SPIRENT, “IMS Architecture : The LTE User Equipment Perspective,” 2012.

[5] ETSI, “European Telecommunications Standards Institute,” 2014. [Online]. Available: http://www.etsi.org/.